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Forestry Research West

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A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

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In This Issue

Cover

A unique timber harvest study that began over 50 years ago (pictured here) has been given new life for at least another 50 years. Researchers at the Pacific Southwest Station have resurrected studies at the Blacks Mountain Experimental Forest to examine the balance of forest management with the demands of people and the needs of a functioning forest. Read about it on page 10.

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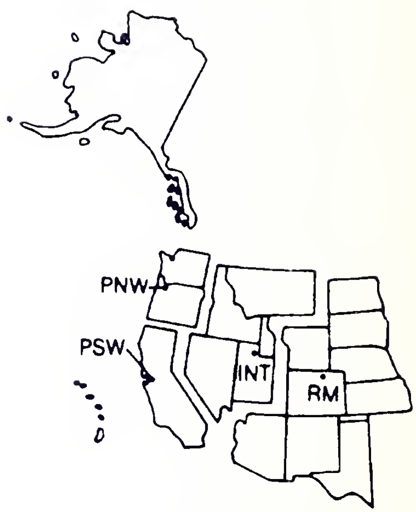


Satellites hunt the hunters

by Bert Lindler
Intermountain Station

Biologists are tracking elk hunters in western Montana. They're not trying to learn the hunters' secret spots; they're trying to learn how to help more bull elk survive the hunting season.

Hunters face few restrictions when hunting bull elk in many western states. In areas with easy road access, only one bull elk may survive the hunting season for every 20 cows. In the absence of hunting, herds could have about one bull for every two cows. Biologists are concerned that one bull for every 20 cows may be too few.

Hunters volunteer to cooperate in the research by carrying global positioning systems with them in their backpacks while stalking elk. The hunter's location is tracked at the same time elk movements are documents

During the 1993 hunting season, 17 hunters carried small global positioning system units in their backpacks during 29 outings. Every 15 seconds, the unit used signals from global positioning satellites to determine the hunter's location. The unit stored all the locations in its memory. Later, at the Intermountain Research Station laboratory, Forest Service Biologist Jack Lyon and Milo Burcham of the University of Montana recreated the hunts on a computer screen. They learned that:

- The average hunter went only 1 1/2 miles from the trailhead
- Less experienced hunters walked farther and climbed higher than more experienced hunters.
- The average hunter spent nearly one-fourth of the time walking on roads, most of which were closed.
- Less experienced hunters spent twice as much time walking on roads as more experienced hunters.
- More experienced hunters stayed out longer than inexperienced hunters and hunted farther from the roads.

Last fall, another 45 hunts were recorded. Some hunters were afoot, some were on horseback, and others were riding mountain bikes. All were helping biologists in this unusual study.

The hunter study is just one of four studies on elk vulnerability and forest fragmentation in the Garnet Range, about 40 miles east of Missoula, MT. The area is especially suitable for research because the relationships between elk habitat and logging have been studied there since 1970. In addition, hunter access is limited to a few specially designated trailheads. Biologists can gauge hunting pressure by counting vehicles at trailheads.

About 300 elk use the area. Each year, biologists track about 20 to 30 elk they have outfitted with radio collars around their necks. From the spring through the fall, researchers fly over the study area at least once a week to locate the elk. One study will show whether the elk have changed their habitat use and home ranges in response to logging; another will show how much time elk spend in different habitat types, particularly during the hunting season.

The final study should tell biologists more about the areas where hunters kill elk. When hunters report killing an elk in the study area, biologists go to the spot and record the location using a global positioning system unit.

Data from the studies are being collected in a geographical information system, a computerized network that allows researchers to keep track of many different types of information by location. Since the roads and habitat data are in the GIS, it's easy to figure out the type of habitat an elk was using when it was killed during the hunting season, or how far it was from the nearest road.

Researchers have completed the second of three field seasons. "We're trying to document how fragmentation is affecting mortality," said Burcham, who is in charge of field research for the studies. Many small clearcuts can leave a forest looking like Swiss cheese: lots of openings with very little continuous forest. Biologists call this fragmentation. "We're checking if these places, where elk are killed, show higher indices of fragmentation than other areas elk use," Burcham said.

"An earlier study in this area showed that elk benefited from road closures once an area had been logged," said Dave McCleery, wildlife biologist for the Bureau of Land Management's Garnet Resource Area. He hopes these studies will suggest other types of management that will benefit elk in drainages fragmented by logging.

These studies involve cooperation by the University of Montana, the Bureau of Land Management, the Intermountain Research Station, the Montana Department of Fish, Wildlife and Parks, the Rocky Mountain Elk Foundation, the Boone and Crockett Club, and Plum Creek Timberlands, L.P. McCleery hopes this cooperation helps translate research findings into management recommendations.

Abstracts of two papers on the studies were published in the Proceedings of the Western States and Provinces 1995 Joint Deer and Elk Workshop, held in Sun Valley, ID, from May 23 to 25. The abstracts were published by the Idaho Department of Fish and Game. The two abstracts are: "Comparison of Elk Home Ranges and Core Areas Before and After 10 years of Timber Harvest," by Milo Burcham and C. Les Marcum; and "Tracking Elk Hunters with Global Positioning Systems," by L. Jack Lyon and Milo G. Burcham.

The results of this research will help natural resource managers know how to manage both motorized vehicle use and security cover for bull elk to allow more bulls to live to old age

A young bull elk waits for researchers to attach the radio collar that allow scientists to locate it in relation to hunters movements

The forest ecosystem study: a spotted owl cafeteria?

by Sherri Richardson
Pacific Northwest
Research Station

Andy Carey recalled the first news coverage a regional paper gave the Forest Ecosystem Study he is leading.

"Our early news coverage was interesting," Carey explained. "One of the local papers ran a story and a logger wrote a letter to the editor saying we were busy boring holes in trees and doing other things to help maintain a spotted owl cafeteria."

Carey, a Principle Research Biologist at the Pacific Northwest Research (PNW) Station, is leading the Forest Ecosystem Study which is based at Fort Lewis, near Seattle, Washington. The thrust of the study is to make second-growth forests look, feel, and act more like old-growth forests. To achieve that objective, part of the research involves developing habitat for flying squirrels, the primary prey for the spotted owl.

But that, of course, is not the entire focus of the research. Ancient forests have been dwindling in the Pacific Northwest. The controversy over how the remaining old-growth forests should be managed has resulted in several court challenges, environmental impact statements, and major interagency reports: "Interagency Scientific Committee to Address the Conservation Strategy of the Northern Spotted Owl" (1990), "Scientific Analysis Team Report" (1993), and the "Forest Ecosystem Management Assessment Team Report" (1993).

According to Carey, all of these reports "emphasized the need for a landscape-level approach to biodiversity management" and "ecosystem-level studies" of how to re-create old-growth forest conditions through management of second-growth forests.

Carey's Forest Ecosystem study offered to address this issue. The study, which began in 1991, is a partnership among the PNW Station, the US Army's Fort Lewis, the USDA National Research Initiative (Competitive Grants Program), and Oregon State University. The study is being done on 145 acres of land on the Army's Fort Lewis and is scheduled to run for about 20 years. It is being funded through combined grants totaling about $2 million.

History of the study

The Interagency Scientific Committee's (ISC) spotted owl report was one of the actions that laid the groundwork for Carey's study. The 1991 report focused on research that would determine if habitat for spotted owls could be created or retained while still meeting the commercial interests of a forest. The following year, one-time funding was provided by the Forest Service's Spotted Owl Research, Development, and Application (RD&A) Program for research by using silviculture to accelerate the development of spotted owl habitat in managed forests.

Carey, who is based at a PNW laboratory in Olympia, Washington, was among the group of scientists assigned to develop a set of studies to fulfill the RD&A objectives. "One of those studies was for experimental manipulation of managed stands," Carey explained. "Interest in the study was expressed by the Washington Department of Natural Resources, Weyerhaueser Corporation, and Fort Lewis. After reviews of the locations and negotiations, Fort Lewis was chosen as the site."

The PNW Station and Fort Lewis became partners in the study, and Fort Lewis guaranteed a tract of land for the experimental study. About 145 acres were set aside for the research.

Study objectives

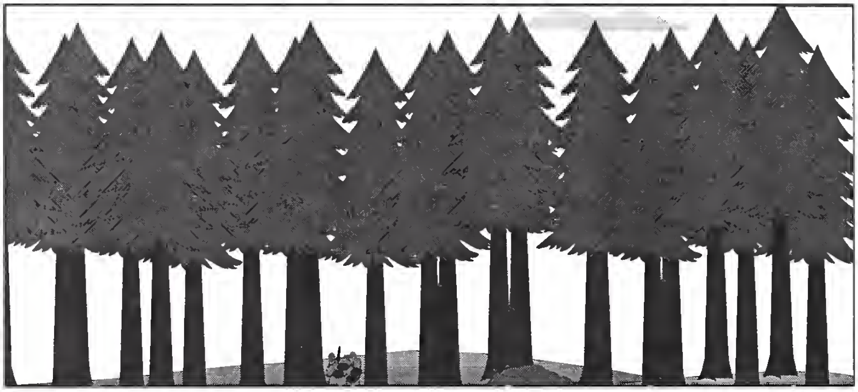
The applied research objectives will determine if:

- providing cavities for the primary prey of the spotted owl, the northern flying squirrel, will increase the population of flying squirrels
- owl habitat can be duplicated in forests by using silviculture prescriptions
- silviculture manipulation will increase plant, fungal, and animal diversity, the abundance of flying squirrels, and tree growth over time

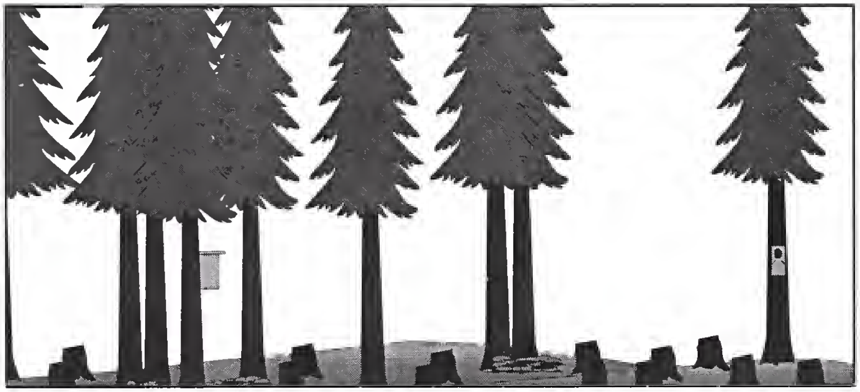
Basic research objectives include:

- providing a clear understanding of the ecology of ectomycorrhizal fungi as it relates to climatic changes and how this impacts rodent and plant populations

- evaluating the den sites and diversity of forage for the northern flying squirrel, Douglas' squirrel, and Townsend's chipmunk populations
- understanding what affects the composition and population size of mammals that live on the forest floor—especially how vegetation and coarse woody debris may impact these populations
- developing indexes to forest ecosystem health, based on soil food webs and small-mammal communities



Panel 1 Pretreatment



Panel 2 Treatment (thinning, nestboxes, cavities)

The plan

The Forest Ecosystem Study has been established in four large blocks of four adjacent stands, each receiving a different treatment: no treatment (control), cavities, thinning, and thinning (with cavities).

"We are doing the thinnings in a new way," Carey said. "We call it variable-density thinning to produce a mosaic of varying tree densities and understory patches. This allows us to open the stand. We are basically incorporating a light and heavy thinning in a 2:1 ratio by using half-acre patches."

Heavy thinning on a large scale can lead to:

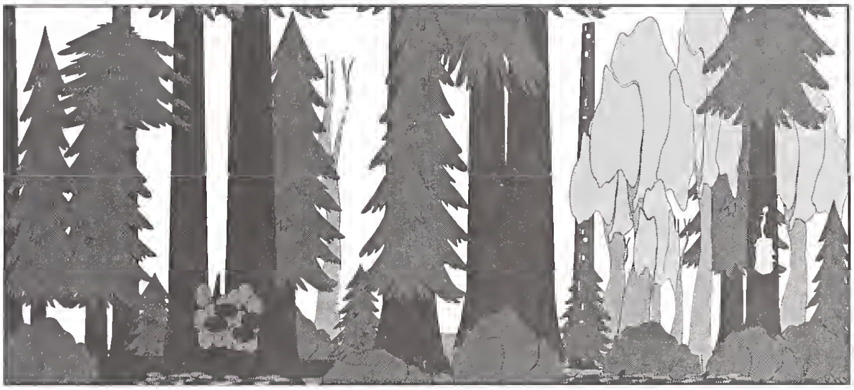
- dense, uniform understory
- understory vegetation that is too simple (not enough variety)
- lots of fallen trees (wind is too strong, too few trees to block it)
- invasion of grasses and herbaceous plants, which in turn changes soil ecology, sometimes leaving soil that is not conducive to tree growth

Variable-density thinning:

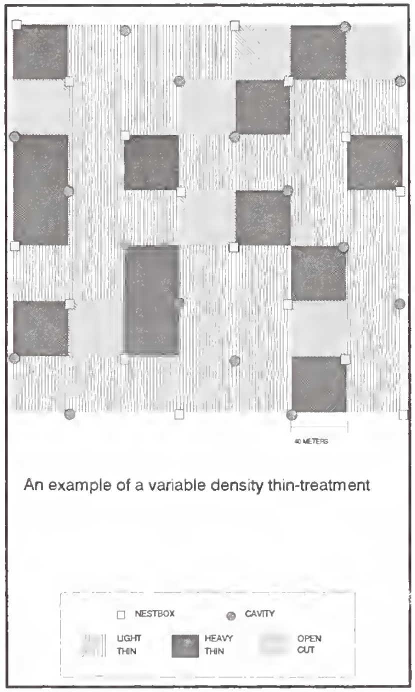
- enhances ecosystem robustness
- promotes understory diversity
- maintains wind firmness (trees do not blow down as easily; they are protected from the wind)
- closely mimics natural processes
- incorporates leaving some trees for coarse woody debris and snags
- incorporates creating living cavity trees
- promotes top rot, through fungal inoculation, to provide future homes for flying squirrels and woodpeckers

"We are doing some stand and landscape simulations to show how the forest will look when it is managed for biodiversity, preserved—not managed, or managed strictly for timber-fiber production," Carey explained.

Panel 3 Post treatment



Panel 4 Desired future condition of forest



Panel 5 An example of variable-density thinning

Sampling plan

The grid sampling plan of the tract on Fort Lewis will also allow researchers to examine and look at a wide array of organisms and life forms in the forest: fungi, vascular plants, small mammals, and predators (owls and weasels).

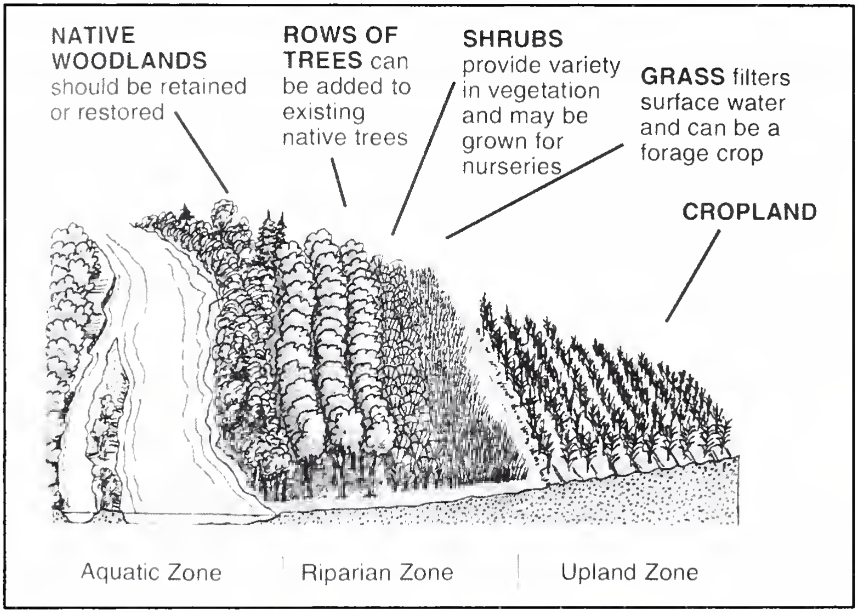
Other researchers participating in the study include PNW scientists Catherine Parks and Randy Molina, Botanist Dave Thysell, Statistician Jan Kershner, Data Manager Barbara Young, and Wildlife Biologists Angela Bargmeyer, Greg Braden, Karma Gerth, Bruce Haveri, Charley Knox, Lisa Villa, Suzanne Wilson, and Todd Wilson. Oregon State University Scientists include Jim Trappe, Elaine Ingham, Michael Holmes, Tim Schowalter, and doctoral candidates Wes Colgan and Betsy St. Pierre. Many volunteers and interns also assisted with the study.

"The experiment at Fort Lewis will help us identify the key factors that distinguish ecosystem management from single-minded management that is ecologically incomplete," Carey said. "Even this experimental study is incomplete. Additional areas of investigation have been identified. But the conceptual basis of the experiment will provide food for thought and a stepping stone for designing ecosystem-management systems."

For more information on the Forest Ecosystem Study, contact Andy Carey at the Olympia Forestry Sciences Laboratory, 3625 93rd Avenue SW, Olympia, WA, 98512-9193.

Putting trees to work for agriculture

by Bill Rietveld
National Agroforestry Center



An example of how agroforestry practices can be integrated into a farm operation to make it more productive and sustainable

The land is the lifeblood of our Nation. Year after year, America's farmers till the soil, bringing new life from the ground. We feed ourselves and much of the World because of productive lands and powerful state-of-the-art technology. But will our land be so bountiful for future generations? Are we being good stewards, putting more back into the land than we take out? Are we sustaining a way of life that assures our planet's great bounty for generations to come?

Keeping that in mind, imagine for a moment something that could increase crop yields, control wind erosion, and reduce home energy costs. What if it could also protect livestock from cold winter winds and hot summer heat, improve their weight gain, and increase milk production? And, what if this product could increase water-use efficiency, protect wildlife, absorb water-polluting runoff, improve water quality, keep winter roads clear of snow, and, in general, provide multiple long-term benefits for farmers? Too good to be true? Not if you're talking agroforestry - putting trees to work for agriculture.

Agroforestry is an intensive land management system that optimizes the benefits from the interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock. Agroforestry has been practiced around the World for centuries, but, in the United States, it is a relatively new concept. Prior to the recognition of agroforestry, our focus was on traditional private forestry and farmland practices designed for a single landowner and purpose. However, since the 1980's the concepts of agroforestry have grown and evolved to address critical economic, environmental and social issues confronting U.S. agriculture - soil erosion, water quality, biodiversity, rural economic diversification, and sustainability.

Agroforestry practices can bring dividends in ways many of us may have never imagined. Take, for instance, alley cropping - widely spaced single rows of trees planted in an agricultural field. Such a system can provide fruits and nuts for harvest, shade for shade-tolerant crops, and ultimately a woodlot.

Agroforestry can also mean windbreaks. These plantings help protect crops, livestock, buildings and roads from blowing snow, drying winds, and dust, and can reduce noise and provide habitat for wildlife.

Tree and shrub plantings are also important around streams, lakes, ditches and wetlands, where they create riparian zones. These plantings help stabilize streambanks, reduce nonpoint source pollution, enhance aquatic and terrestrial habitat for wildlife, improve landscape aesthetics, and provide harvestable products.

Plantings also create favorable "microclimates" for livestock to rest under, and for forage and specialty crops, such as ginseng or shittake mushrooms.

The National Agroforestry Center

To help foster the agroforestry concept in the U.S. (and even now internationally) the 1990 Farm Bill authorized the creation of the National Agroforestry Center (formerly the Center for Semiarid Agroforestry). Located in Lincoln, Nebraska, the facility operates as a partnership between the Research, State and Private Forestry, and International Forestry branches of the USDA Forest Service. Its primary client is State and Private Forestry (FS), specifically natural resource professionals in state forestry agencies who provide technical assistance to landowners and work with numerous cooperators under the forest stewardship, economic action, urban and community forestry, forest health management and natural resource conservation education programs. The Center's research and technology transfer functions are also important to the Natural Resources Conservation Service and other federal and state agencies that deliver technical assistance and cost-share programs to landowners. The Center is an expansion of the Rocky Mountain Station's "Improvement of Stress- and Pest-Resistance of Great Plains Tree Species" research work unit, also located in Lincoln, that has over 40 years of conservation forestry research experience under its belt.

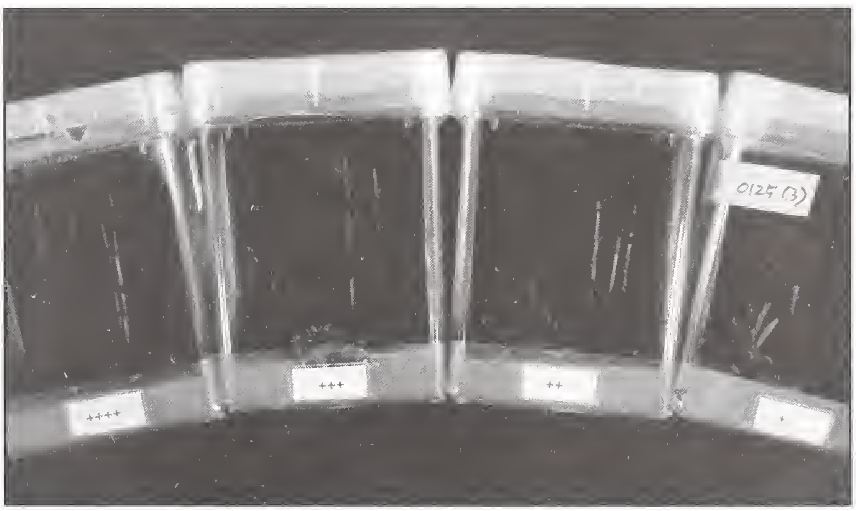
In addition to the research unit, the NAC has two other components: 1) Technology Transfer and Applications (funded by State and Private Forestry, it was recently designated a S&PF national center of excellence for agroforestry, and has national responsibility), and 2) International Technology Exchange (a new component, it is expected to be funded beginning in fiscal year 1996).

Bill Rietveld, NAC Program Manager, states, "environmentally sound, sustainable development in agricultural ecosystems is one of our Nation's most complex and critical issues. Our challenge is to reduce the environmental impacts of agriculture and protect natural resources, while maintaining productivity and profitability and providing for people's needs. Agroforestry is helping create this "win-win" situation," he says. "Few practices can match the ability of agroforestry to provide lasting economic, environmental, and social benefits. Integration of agroforestry practices can transform our agricultural lands into productive, resilient, diverse, and sustainable land-use systems," says Rietveld.

NAC is more than a center for accelerating the development and application of agroforestry technologies; it is a contact point, clearinghouse, and catalyst that serves as a driving force to accelerate a process that may otherwise occur slowly or not at all.

Research highlights

The Center's research unit works with numerous domestic and international cooperators to develop stress- and pest-resistant multipurpose trees and various technologies necessary to successfully reap the benefits of agroforestry systems. Project Leader Michele Schoeneberger explains, "Research, spanning from long-term field trials, to laboratory-



Green ash trees with desired traits can be multiplied using tissue culture

focused molecular genetics, is being used to select trees better adapted to the harsh climate and insect and disease pests of the Great Plains. We are developing propagation techniques to accelerate the transfer of desirable traits into future tree plantings."

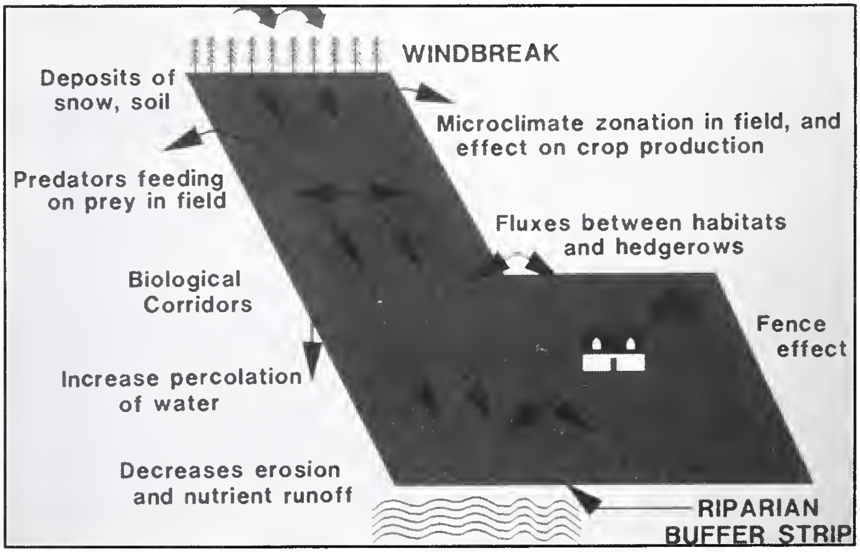
Research is also underway on the numerous ecological interactions created by agroforestry systems, with a goal of designing systems that capitalize on the beneficial ones. Tree windbreaks, if planted correctly, can alter the microclimate so that crop yields are increased. Scientists at NAC are finding that these same windbreaks have the potential to enhance habitat for birds, insects and spiders that are natural enemies of tree and crop pests. Such "biological control" of pests can reduce the use of chemical pesticides. NAC scientists and their cooperators are also learning just how important agroforestry plantings are as habitat for wildlife species ranging from important game (i.e. pheasant) to nongame (i.e. neotropical birds) species. Data from these studies are being used to address critical environmental concerns, from biodiversity and sustainability, to projected climate change. Modelling efforts are looking at the roles of agroforestry plantings in the Great Plains under hypothesized climate scenarios. Preliminary results indicate crop windbreaks can assist crop production under shifting temperature and moisture regimes.

"Water quality problems facing the agriculturally-dominated Great Plains has brought our research on forested riparian buffer systems to the forefront," says Schoeneberger. We are investigating how and where these plantings can be utilized to filter, trap and degrade pollutants before they enter waterways, and their significance as wildlife and fish habitat and their importance to aesthetics, recreational opportunities, biodiversity and tree products," she said.

"Our research results are helping develop management tools and strategies for farms, watersheds and landscapes that blend and balance agroforestry with other land-use practices to increase agroecosystem sustainability," says Schoeneberger.

TT&A

To help get word out to current and potential users, the NAC's Technology Transfer and Applications (TT&A) program works within a nation-wide network of partners and cooperators to develop and distribute agroforestry information and tools, create guidelines, and adapt and apply agroforestry technologies. Program Leader Jerry Bratton explains, "the TT&A program uses a variety of media and activities to meet clients' specific needs. One is "Inside Agroforestry", a quarterly newsletter designed to keep natural resource professionals informed of current information and events. The Center works with cooperators to develop tools, guidelines and workshops for those who provide technical assistance to landowners. A new



Multistrata riparian buffer strips are a good example of how agroforestry practices help mitigate the environmental impacts of agriculture, and provide numerous other benefits, including income from timber and other tree products

application notes series titled "Agroforestry Notes" provides technical information in a useful "how-to-do-it" format. Other media include videos, displays, technical guides, published papers, and literature searches.

TT&A also cost-shares in: demonstrations of agroforestry technologies in both rural and community environments; applications projects with cooperators to evaluate and adapt technologies under local conditions, to pave the way for general adoption; and assessment projects to assemble or develop information to advance agroforestry.

Finally, the Center initiates special projects to address specific needs or unique opportunities. For example, the Center developed the Native American Agroforestry Project to assess and demonstrate how agroforestry systems can be applied on tribal lands to meet the unique societal, economic, and spiritual needs of tribes; and a Working Trees for Communities project to apply agroforestry technologies in communities and the rural/urban interface.

Several municipalities have put agroforestry principles to work. For instance, the Laramie County Conservation District in southern Wyoming replaced traditional slated fences with "living" snow fences, saving taxpayers up to $4,933 per mile per year. In this county alone, its 53 living snow fences are saving roughly $74,000 tax dollars annually.

The Winnebago Indian Tribe in Nebraska is adapting agroforestry to several sites by: 1) planting windbreaks to protect sensitive agricultural lands and fruit orchards; 2) planting shrubs that produce raw materials for traditional arts and crafts; 3) establishing an agroforestry alley cropping demonstration project on marginal farmland; and 4) converting marginal farmland to special forest products that provide employment for their people.

Another tribal project involves the Santee Sioux Tribe of Nebraska. They planted windbreaks in pastures to protect livestock from wind and snow during the calving season.

The future of agroforestry

Agroforestry has evolved and grown a great deal since the 1990 Farm Bill. "It is coming of age," says Rietveld. "Agroforestry is now clearly of national importance, with strong interest and support in all parts of the Country. It is being recognized as an integral part of sustainable agricultural land-use systems."

Rietveld qualifies his enthusiasm about the future of agroforestry by saying, "for the full potential of agroforestry to be realized, it needs to be considered a part of farm, watershed, and landscape systems everywhere." And it <u>is</u> spreading to "everywhere." The Center's work initially focused on agroforestry in the Great Plains of the U.S.. Today, efforts are not only expanding to all 50 states and U.S. territories, but are beginning to branch out internationally. "We're working with the Forest Service's International Forestry branch to develop partnerships to share knowledge with agencies, universities and organizations worldwide. It's an exciting time," says Rietveld.

In addition, an important partnership is being formalized with the Natural Resources Conservation Service; and partnerships with USAID (U.S. Agency for International Development) and CSREES (Cooperative State Research, Education and Extension Service) are being developed. Memorandums of understanding have also been signed to implement the "Working Trees for Tomorrow's Communities" program which will apply agroforestry technologies to help mitigate environmental problems in communities, as well as in the rural/urban interface. Finally, the recent release of the Resource Conservation Act's National Assessment for Agroforestry was a stimulus that lead to a workshop last summer that formulated a unified national strategy to develop and implement agroforestry. "Now that everyone is reading from the same page, we look forward to building more bridges between the forestry, agriculture, and environmental communities," said Rietveld.

For additional information on the National Agroforestry Center, contact Bill Rietveld, National Agroforestry Center, East Campus, University of Nebraska, Lincoln, Nebraska 68583-0822, (402) 437-5178, ext. 27, Fax: (402) 437-5712.

Blacks Mountain Study: a commitment to sustainable forest management

by Louise Mastrantonio and the Blacks Mountain Team

Early 1940's at Blacks

A study begun by the Pacific Southwest Research Station more than 50 years ago is getting a new lease on life—an entirely new purpose and a projected time frame of at least another 50 years.

The old study was established in the Blacks Mountain Experimental Forest (BMEF) in the 1930's and 1940's, and examined different levels of harvesting timber. It was designed to determine what minimum levels of timber harvest could be economically feasible over large areas, and to determine the differences in tree growth over time. The new study takes a holistic approach to answer complicated ecological questions by examining the responses and interactions of many forest components to different forest structures within an interdisciplinary, experimental framework. A key goal of the research is to provide useful information for achieving the necessary balance of forest management to simultaneously meet the demands of people and the needs of a functioning forest and its soils, plants, invertebrates, and wildlife. Questions to answer include: How do the forest's functions, or ecological processes change through time? How do they respond to different forest management strategies?

A serendipitous beginning

As often happens, the new project had a somewhat serendipitous beginning. It began in 1990 when Bill Oliver, a research silviculturist at Redding, and administrator of Blacks Mountain Experimental Forest, asked if anyone was interested in embarking on an interdisciplinary study using the early silvicultural studies as a base.

The response from many scientists working in different disciplines was an overwhelming "yes." As they talked about the importance of the 50-year data base at Blacks Mountain, they began to see new opportunities for research within a different framework. Out of the first meeting in 1991 came a commitment to develop a new research plan for Blacks Mountain that would address some of today's concerns. The study would be on the cutting edge for developing research technologies and integrating information to answer large, complex questions. "We had always given lip service to interdisciplinary studies," Oliver says, "but we really didn't know how to go about it."

The team has now worked together for more than four years and has developed techniques and processes necessary to conduct interdisciplinary research on a variety of scales.

Why Blacks Mountain?

Located some 37 miles northwest of Susanville in the Lassen National Forest, and set aside as a research area in 1934, Blacks Mountain presents an ideal opportunity to implement interdisciplinary experiments. In the past, most forestry research was conducted on small plots, and narrowly-focused by discipline. All that is changing as a result of increased understanding from small-scale, individual research projects. Questions relative to current and future forest structures, as well as those based

on larger geographic and temporal scales, will be answered at Blacks Mountain. Both sets of these questions are directly related to important aspects of BMEF:

1. Long-term data base
2. Large acreages available for treatment replication
3. A relatively unaltered pine forest with a good component of large diameter trees and snags
4. Baseline information on birds and small mammals.

Blacks Mountain Experimental Forest is largely forested with eastside pine, a major forest community that extends from Baja California north through eastern Oregon and Washington and into British Columbia. These forests consist primarily of ponderosa and Jeffrey pine, with white fir and incense-cedar also present. Eastside pine is valuable for timber and cattle production, clean water, outdoor recreation, and habitat for a variety of wildlife.

Major problems also exist within this forest type; temperature extremes — hot in summer and cold in winter — and low precipitation combine to create difficult growing conditions. Decades of use and wildfire exclusion in the 20th century, combined with other factors, have resulted in less than fully productive forests that seem to be prone to bark beetle outbreaks. The risk of catastrophic fire is high, and many ecological processes have been altered.

Both future forest health and the economic base of local communities depend on new management techniques. As foresters move more and more toward practices that emphasize long-term productivity and ecologically sound management strategies, they will rely heavily on forestry research for basic ecological information about the way forest ecosystems function.

The study

Through interdisciplinary research, scientists will be able to determine how alternative forms of forest management affect the processes and properties of ecosystems that control the health, productivity and sustainability of their principal components.

Ecosystem interactions and emergent properties can be understood only if two or more

Collecting vegetation data

factors are studied together. Physically, this is difficult when some factors (such as bacterial mineralization of organic matter) are studied on a micro-geographic or temporal scale, while others (such as habitat needs and/or reproductive success of cavity-nesting birds) are studied more broadly. The relationship between, and influences of, the various forest properties and processes can be determined by knowing the exact location of the data in the landscape and, in time, the community conditions that it represents. Findings can then be discussed with specialists in other disciplines who are involved with similar or related communities. Spatial and temporal integration of the findings from field studies of differing scales will be achieved by referencing all data to permanently monumented plot centers accurately located on a 100-meter grid. This grid will facilitate the integration and extrapolation of information obtained from periodic sampling through time.

To further facilitate this, geographically-referenced digital orthophotos will be used to determine the spatial distribution of plant communities. The photos will permit a description of the landscape at varied spatial scales, and subsequent photos will show how the treatments and vegetation response to such have altered the landscape through time. Data will be stored in a corporate relational data base, and analysis will include the use of geographic information systems. Structure refers to the shape of a forest: its height, the diameter of trees, and the spacings

around trees and groups of trees. The study design compares the effects of two different forest structures (high diversity and low diversity), two grazing strategies, and two fire treatments on forest ecology. The treatments will set the evolution of forest structures on eight different paths. Various forest attributes will respond differently to these treatments through time.

The study consists of twelve 250-acre plots. Six of the plots will be harvested to high structural diversity, and six to low structural diversity. These structures will be created by timber sales planned for the summers of 1995, 1996, and 1997. Grazing will be excluded from half of the high diversity and half of the low diversity plots. Each of the 250-acre plots will be split, and fire will be re-introduced (and maintained on a regular basis) on each of the 125-acre splits.

After logging, each 250-acre high diversity treatment area will contain many large, old trees, abundant snags, multiple canopy layers with dense clumps of smaller trees, and small openings. Each low structural diversity treatment area will have few large trees and snags, and a single canopy layer with trees well spaced, and a few large gaps in the forest canopy.

The fire treatment will reduce the amount of woody debris and forest floor litter on half of each of the treatment areas. It will also increase nutrient availability through mineralization, provide optimum places for plant seed germination, and stratify seeds, which encourages them to sprout. The grazing treatments will result in the trampling of woody debris, mixing of upper soil layers, and consumption of sprouting grasses and forbs.

The responses of various forest attributes (including soils, vegetation, genetics, and wildlife) and the interactions of ecological processes (nutrient mineralization, plant growth, and wildlife population changes) that will result from the treatments are unknown. The important question: is there a real difference between management strategies through time?

Measuring circumference of trees for data collection

The research team

Scientists involved in the study include: Dr. Pat Shea and Dr. George Ferrell, entomology; Dr. Bill Laudenslayer, wildlife ecology; Bill Oliver, plant ecology; Dr. Bob Powers, soil processes; Dr. Phil Weatherspoon, fire ecology; Nathan Skinner, landscape ecology; Dr. Jim Laacke, forest regeneration; Dr. Connie Millar and Dr. Safyia Samman, forest genetics; Dr. John Menke, range science; and — to help keep the data statistically sound — Dr. Sylvia Mori, statistics. Others who have worked on the project include: Leroy Dolph, mensuration, and Dr. Ray Ratliff, range science, both retired; and Dr. Bill Otrosina, pathology, no longer with the study. Research scientists from the Moscow Forestry Sciences Laboratory, Michigan Tech., and Humboldt State are also cooperating in this effort. Scientists are invited to join the group if they think they have something to contribute to the research at Blacks Mountain.

Kathy Harcksen, a full-time team leader, coordinates the project. Her responsibilities are to facilitate the efforts of the research team, oversee planning, and serve as liaison to National Forest and other

cooperators. This role relieves scientists of the administrative burden and allows them to continue their research.

A grass-roots effort

For most researchers at Blacks Mountain, this is their first experience as part of an interdisciplinary team. Their observations reflect real enthusiasm for the project:

- "This study has been a grass-roots effort. People are doing this work because they have a commitment to learning what we need to know about long-term forest productivity."
- "The real beauty of this effort is that we have entomologists, silviculturists, fire ecologists, soils people... all working together. As we started to plan the project... this disparate group of specialists... we began to ask questions that were interdisciplinary in nature."
- "It would be much easier to be an individual scientist doing your own thing. You have to be willing to give up some of your freedom to do this type of work. But it's worth it. Rarely do you have an opportunity to work on replicated research plots that are 250 acres in size."

All of the studies are planned with certain objectives in mind; scientists want to learn things that will have practical application in forestry. But no one knows exactly what will come out of this work. "We expect surprises," Oliver says. "Through the collaboration of scientists working in different disciplines, we will undoubtedly find many environmental relationships we simply cannot foresee."

Goals

Overall goals of the project are to:

- Develop basic biological and ecological information about the eastside pine forests,
- Provide information on the responses of forest ecosystems to natural and human-induced disturbances,
- Determine methods to restore ecological processes, and
- Develop strategies for old-growth management.

In the past, most ecological studies were not designed to assess the effects caused by specific activities, nor were they intended to answer questions relevant to more than one discipline. As a result, it has been difficult to draw broad conclusions on the effects of activities on the array of ecological components within a forest. At Blacks Mountain, scientists have put considerable effort "up front" into planning a study that would answer big questions on biodiversity and sustainable productivity, and that would provide statistically-sound information for years to come. That is the special interest of Dr. Pat Shea. Shea was involved in large insecticide studies in the 1960's and 1970's. Those studies, which included analyzing the effects of insecticides on birds and wildlife, have helped him appreciate the importance of good experimental design. "Fifty to 100 years from now, we want researchers and managers to have confidence in the data base," he says.

Studies underway and planned

Many studies are now underway or planned. Some of these include:

- Plant ecology: Scientists are installing permanent vegetation plots keyed to the 100-meter grid to document changes in forest vegetation structure, density and species composition through time. They measured these plots before the treatments and will measure them after the treatments and at intervals thereafter. Vegetation attributes measured include: large and small trees, shrubs, forbs and grasses, forest litter and downed logs.
- Wildlife ecology: Baseline fluctuations in populations of birds, mammals, reptiles, and amphibians have been established. Scientists will evaluate the responses through time to changes in forest structure caused by the treatment combination.
- Forest genetics: Researchers are documenting baseline genetic information on trees, shrubs, and grasses, and they will evaluate any changes resulting from treatments.
- Snags: Scientists are evaluating the characteristics that make snags attractive to wildlife,

especially cavity-nesting birds, and they are developing methods to achieve these characteristics.

- Bark beetles: At Blacks Mountain, entomologists will have a unique opportunity to assess the claim that bark beetles do relatively little damage in a healthy stand that has high structural diversity.
- Soil processes: Scientists will study how nitrogen is added to the soil through the decay of downed logs and nitrogen-fixing plants, and the effect of logs on root distribution. Researchers will also look at the effects of trampling by cattle and logging activity on soil characteristics at or near the surface.
- Fire history: The Blacks Mountain study will also document the frequency and intensity of past fires, and how forest structure developed in the presence of fire.
- Fire ecology: The effects of prescribed fire at and near the soil surface will be examined, as well as its effects on vegetation growth rate, seedling production, and mortality. The effect of grazing on the intensity of prescribed fire will also be determined
- Range science: Range scientists will evaluate the effects of grazing and prescribed fire on abundance and species of plants, plant production, and soil properties.

The research team will determine the interaction of these components before and after treatments are installed, as well as any differences between treatments. Through time, any significant differences in forest management strategies will become evident.

Prescribed burn used to determine the effect of fire on forest components

A long-term commitment

Ecological research is now underway in most major biological regions of the country. Such research is most often an assessment of current conditions and management recommendations financed by the National Science Foundation or by the USDA Forest Service through its regional experiment stations. The Blacks Mountain research project is a unique ecological study that utilizes a cause-and-effect approach.

Scientists involved in the Blacks Mountain study have, essentially, a lifetime commitment to their work and to this particular project. "No one has to do this research," according to Kathy Harcksen. "They have a commitment to finding the answers to larger questions, and each of them subscribes to the philosophy of interdisciplinary research. Each one has given up a lot, betting that the pay-off in gaining the knowledge pertinent to understanding ecological systems will come in the long run."

For further information on research data resulting from studies at Blacks Mountain Experimental Forest, contact the Pacific Southwest Research Station and request "Long Term Response of Old Growth Stands to Varying Levels of Partial Cutting in the Eastside Pine Type," by Dolph, Mori, and Oliver (Western Journal of Applied Forestry, 10(3):101-108 (1995). This article is now in press and will be provided to interested readers as soon as it is available.

New from research

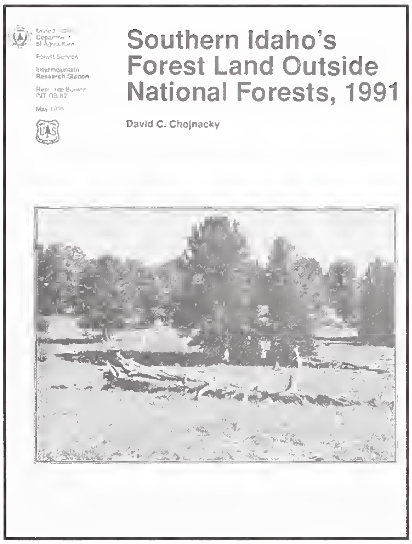
Southern Idaho's forest land outside national forests

Outside of the National Forests in southern Idaho there's 2 million acres of forest land, reports Research Forester David Chojnacky in this new bulletin. On the portion classified as timberland there's 1.8 billion cubic feet of wood. Most of that wood grows in Douglas-fir, ponderosa pine, and aspen forests.

Driving across southern Idaho on Interstate Highway 84, and looking at the sagebrush and cheatgrass stretching almost from horizon to horizon, one must wonder where the almost 2 billion cubic feet woodpile is located. Color maps in this publication show both timberland and woodland. They show where the sample plots were that provided the data for this forest inventory and analysis. The maps quickly reveal that most of the aspen is in the eastern side of the state, while almost all the ponderosa pine grows in the west. This forested land surrounds the Snake River Plain on the fringe of the National Forests.

Fifty-nine tables interpret the information in many useful ways. They summarize timber and wood volumes by county; they show how far the resource is away from existing roads; net annual growth figures help tell how much of the resource could be harvested annually on a sustained yield basis; and they show us that even in the relatively arid southern half of the State there are significant forest resources outside of the National Forests — even though the majority of the timberland is within the National Forests.

Request *Southern Idaho's Forest Land Outside National Forests, 1991,* Resource Bulletin INT-82, from the Intermountain Research Station.



Arid topic is fertile ground for proceedings

Arid land may be a dry topic, but it's fertile ground for the Shrub Research Consortium's latest proceedings. The Shrub Research Consortium includes 25 organizations committed to learning more about shrubs and arid lands.

The subjects of this proceedings range from restoration and revegetation, to ecology, genetic integrity, and management. Arid lands may not be the Earth's most productive habitats, but they are among the most abundant. And in many cases they have suffered from overgrazing or the introduction of exotic plants. Restoring these habitats is important. That's what this proceedings is all about.

Some papers are down-to-earth. For instance, Jayne Belnap and Saxon Sharpe seeded native grasses in Canyonlands National Park in Utah. Some of their experimental plots were fertilized or mulched, others were not. Some were watered to make sure the plots received at least the average annual rainfall, others were not. The results weren't always as expected. Straw mulch reduced seedling survival. So did fertilizer. Russian thistle, an introduced weed, reduced the number of native needle and thread grass plants. But the grasses that grew under the cover of the thistle's spines were bigger than plants that weren't protected from being eaten.

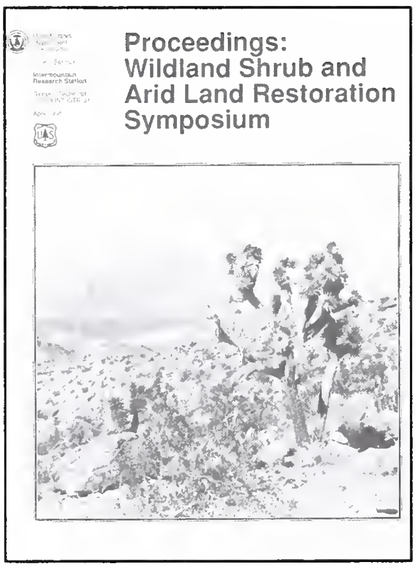
Margaret Brooks studied the appearance of revegetated roadsides in central Arizona. She found that students at the University of Arizona considered the appearance of revegetated roadsides "satisfactory" when the leaves of plants covered 20 percent of the disturbed area. By this measure, only fill slopes (slopes downhill from a roadcut) were successfully revegetated.

Other papers are more theoretical. Steven Whisenant discusses the importance of landscape dynamics when restoring arid lands. He points out the shortcomings of trying to rehabilitate one small area without looking at the larger picture. For instance, planting vegetation in the richer, moisture soils at the base of a hill may not stop the surface of the hill from washing away. Erosion may cut deep channels and steepen the hill's slope, making it difficult for plants to survive at what was once the hill's gently sloping base.

Although most of the papers focus on arid lands in the United States, others address the Karoo shrublands in South Africa and cold deserts in the northwestern Himalayas.

The proceedings includes 62 of the 82 papers and posters presented at the 1993 Wildland Shrub and Arid Land Restoration Symposium in Las Vegas, NV. If this proceedings whets your appetite, you can look forward to the proceedings of the Shrub Research Consortium's May, 1995, symposium in Las Cruces, NM: *"Shrub Ecosystem Dynamics In a Changing Environment."*

General Technical Report INT-315, is available from the Intermountain Station.



Old growth structure and its relationship to fire history

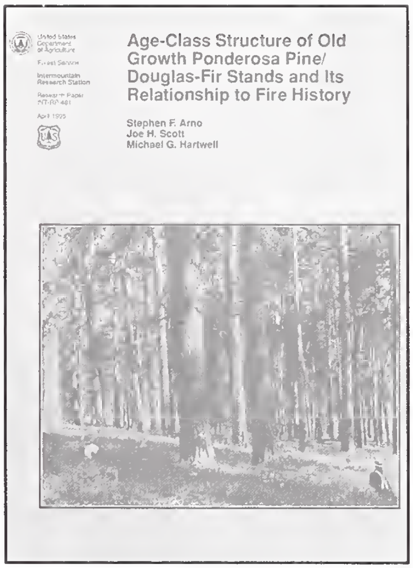
Of all the ecosystem disturbance processes, fire has seemed most fascinating for natural resource managers implementing ecosystem management in the Inland West. With this research paper the Intermountain Station's Missoula fire lab has contributed another piece to the ecosystem puzzle—challenging managers.

In one study site in old growth ponderosa pine, researchers learned that fire has burned the understory an average of every 7 years, for 300 years. Then, starting in 1895, after settlement, no more fires were tolerated by the new civilization.

The forest that resulted is typical of much of the ponderosa pine zone in lower elevations of the Inland West. Insect and disease mortality is epidemic. Dense conifer thickets provide ladder fuels to carry fire into the old growth overstory. Preserving these kinds of old growth forests requires understanding of fire history, age class, and stand structure.

From this study the authors conclude that foresters have passed the point in history where they can preserve ponderosa pine old growth by just allowing fire to return to its historic interval alone. Prescribed fire and silviculture must be combined if managers are to maintain old growth in these zones.

Request *Age-Class Structure of Old Growth Ponderosa Pine/Douglas -fir Stands and Its Relationship to Fire History,* Research Paper INT-481, from the Intermountain Research Station.



Refining space-age forestry with the Prognosis Model

This century of American forestry opened with forest rangers riding alone into the mountains to build their own log ranger station. As the century approaches its close we find foresters describing forests mathematically, geographically locating timber stands with satellites orbiting the earth, and digitizing forests into computer data bases.

Perhaps no event marked the entry of forestry into the space age more than when Moscow Forestry Sciences Laboratory Scientist Albert Stage published the Prognosis model for stand development in 1972. Since then Stage and the Quantitative Analysis Research Work Unit he leads, have continually refined the ability of foresters to use computers to manage the growth and yield of forests.

In this publication, Research Forester David Hamilton helps foresters tailor the Stand Prognosis Model for specific conditions through the use of multipliers. He also alerts Prognosis users to situations where the improper use of multipliers will produce erroneous information.

For space-age foresters already using the Prognosis Model, but who want to make it an even more effective tool, Hamilton's latest publication will serve their needs.

Request *Uses and Abuses of Multipliers in the Stand Prognosis Model,* General Technical Report INT-310, available from the Intermountain Research Station.

Expanding horizons of forest ecosystem management: proceedings of the third habitat futures workshop

Incisive legislation of the late 1960s and 1970s, including the National Forest Management Act, National Environmental Protection Act, and Endangered Species Act, signaled a growing awareness that humans need to be more responsible for the effect they have on the environment.

Prolonged conflicts over complying with these and similar laws, while meeting the economic and social demands for natural resources, forewarned of a need to develop and test new management approaches to resolve such conflicts. The most promising conceptual framework for innovative methods is one based on ecosystem science.

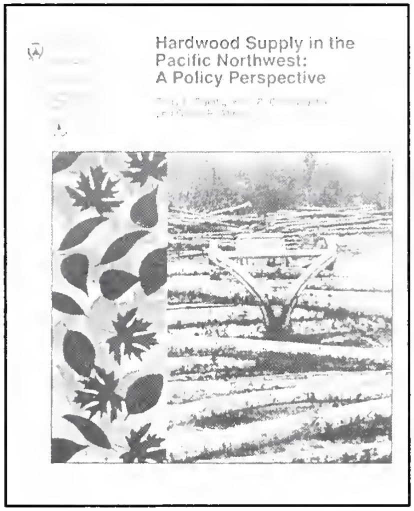
This publication provides a focal point for the dissemination of new findings, concepts, and other information that advance ecosystem science and management. It is also a crossroads where scientists, developers, resource specialists, and managers can come together to provide a clearer understanding of ways to manage ecosystems.

For a copy of *Expanding Horizons of Forest Ecosystem Management. Proceedings of the Third Habitat Futures Workshop*, request General Technical Report PNW-336 from the PNW Research Station.

Hardwood supply in the Pacific Northwest: a policy perspective

Until recently, the hardwood manufacturing industry and associated hardwood forest resources in the Pacific Northwest have played a relatively minor role in the timber economy of that region.

With forests dominated by softwoods, the various hardwood species generally were under-used, and the surplus of growth over harvest gave the region the high hardwood inventories present today. Due to this past surplus, and to softwood timber supply problems in the region, interest has increased in the potential for new or expanded



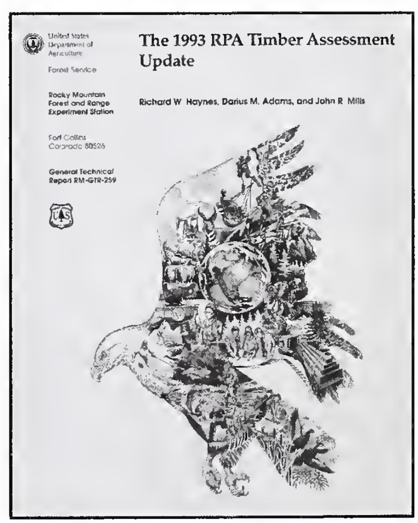
industries, and in increased employment and income from value-added manufacturing based on the hardwood resource.

Interest has intensified with the adjustments occurring in federal timber supply and the changes in public land management policies. This study is part of a larger program of related research and demonstration projects that explores the possibilities for encouraging hardwood forestry and hardwood industry in the rural areas of the region.

For a copy of *Hardwood Supply in the Pacific Northwest: A Policy Perspective*, request Research Paper PNW-478, from the PNW Research Station.

RPA timber assessment update

Another in a series of RPA (Forest and Rangeland Resources Planning Act of 1974) update documents has been issued by the RM Station. Titled *The 1993 RPA Timber Assessment Update*, it reports on changes in the timber resource situation first described in the 1989 RPA Timber Assessment. The report 1) analyzes the timber resource situation to provide projections of the future cost and availability of timber products to meet the Nation's demands, and 2) identifies changing resource conditions that may warrant policy changes, or that may represent opportunities for private or public investment. Copies of General Technical Report RM-259 are available from the Rocky Mountain Station.



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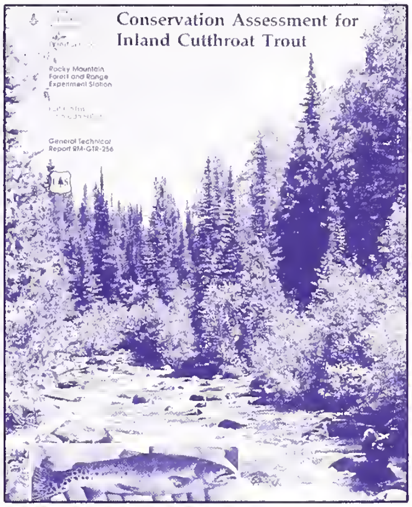
An assessment for inland cutthroat trout

A new report focuses on the state-of-the-science for five subspecies of cutthroat trout found largely on public lands in the Rocky Mountain and Intermountain West. These are restricted to a fragment of their former range, and primarily occupy small, high-elevation streams. All have suffered from introductions of nonnative fishes, habitat degradation and fragmentation, and overfishing. For each fish, the report contains an introduction to the species, life history characteristics, habitat relations, biotic interactions, reasons for concern, causes for the decline, current management practices, and research needs.

Copies of *Conservation Assessment for Inland Cutthroat Trout,* General Technical Report RM-256, are NO LONGER AVAILABLE from the Rocky Mountain Station, but can be found in many university and depository libraries.



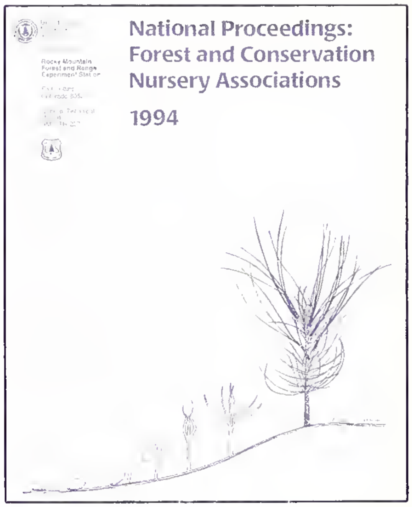
A better bald eagle nest

Scientists with the Rocky Mountain Station have developed a technique of using natural materials to build artificial nests for bald eagles and other raptors. The construction of artificial nests have, in the past, been limited to unnatural materials which are often obtrusive, aesthetically unpleasant, and frequently difficult to secure. This technique should be easily adaptable to any stick-nesting raptor. The nest requires two people about three hours to construct, and should be as secure as any eagle-built nest or human-made platform. Details are available in *Constructing Bald Eagle Nests With Natural Materials*, Research Note RM-535. The Rocky Mountain Station has copies.

Forest and nursery conservation proceedings

A new proceedings is now available from the two 1994 regional meetings of the forest and conservation nursery associations in the U.S. Subjects covered range from seed collection and processing, to nursery cultural practices, and harvesting, storage and outplanting. For a copy, request *National Proceedings: Forest and Conservation Nursery Association - 1994,* available from the Rocky Mountain Station.

Request General Technical Report RM-GTR-257.



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